NEWS NASA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
February 25, 1968

RELEASE NO: 68-36

PRESS KIT

PROJECT: SOLAR EXPLORER B

(To be launched no earlier than Feb. 29)

contents

-0-

2/21/68

NEWS

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

TELS. WO 2-4155
WO 3-6925

FOR RELEASE: SUNDAY
February 25, 1968

RELEASE NO: 68-36

SOLAR X-RAY SATELLITE

The National Aeronautics and Space Administration and the United States Naval Research Laboratory will launch no earlier than Feb. 29, a satellite to measure and monitor solar X-ray and selected ultraviolet emissions.

NRL-NASA Solar Explorer B is scheduled for launch from NASA's Wallops Station, Wallops Island, Va., aboard a four-stage Scout rocket. This is the latest in a series of NRL solar radiation (SOLRAD) satellites for monitoring solar X-radiation throughout the solar cycle.

-more-

2/21/68

A key feature of the satellite, to be designated Explorer XXXVII when orbited, is a digital data storage system which takes information from three of the solar radiation detectors over a 14-hour period by readout on ground command. Other solar radiation data are transmitted in real-time over a standard analog telemetry system.

The international scientific community has been invited to acquire real-time data directly from the satellite.

The Sun is now in the ascending part of its activity cycle with maximum solar activity expected in late 1969. Solar Explorer B, by measuring and monitoring solar X-ray emissions and providing immediate data to interested scientists, is expected to improve forecasts of ionospheric conditions which affect short-wave radio communications. This information will be used in a warning system for major solar flares which may be hazardous to manned space activities.

The satellite is similar to Explorer XXX, launched Nov. 19, 1965, by Navy and NASA. It is still operating on an orbit of 600 by 410 miles. (see NASA Release 65-352.)

The 198-pound spacecraft is 12-sided, 27 inches high and 30 inches across. A central band contains X-ray photometers, Geiger tubes, solar aspect systems and attitude control and spin nozzles. Electric power is supplied by 24 solar cell panels on the satellite's vertical surface and a rechargeable battery pack.

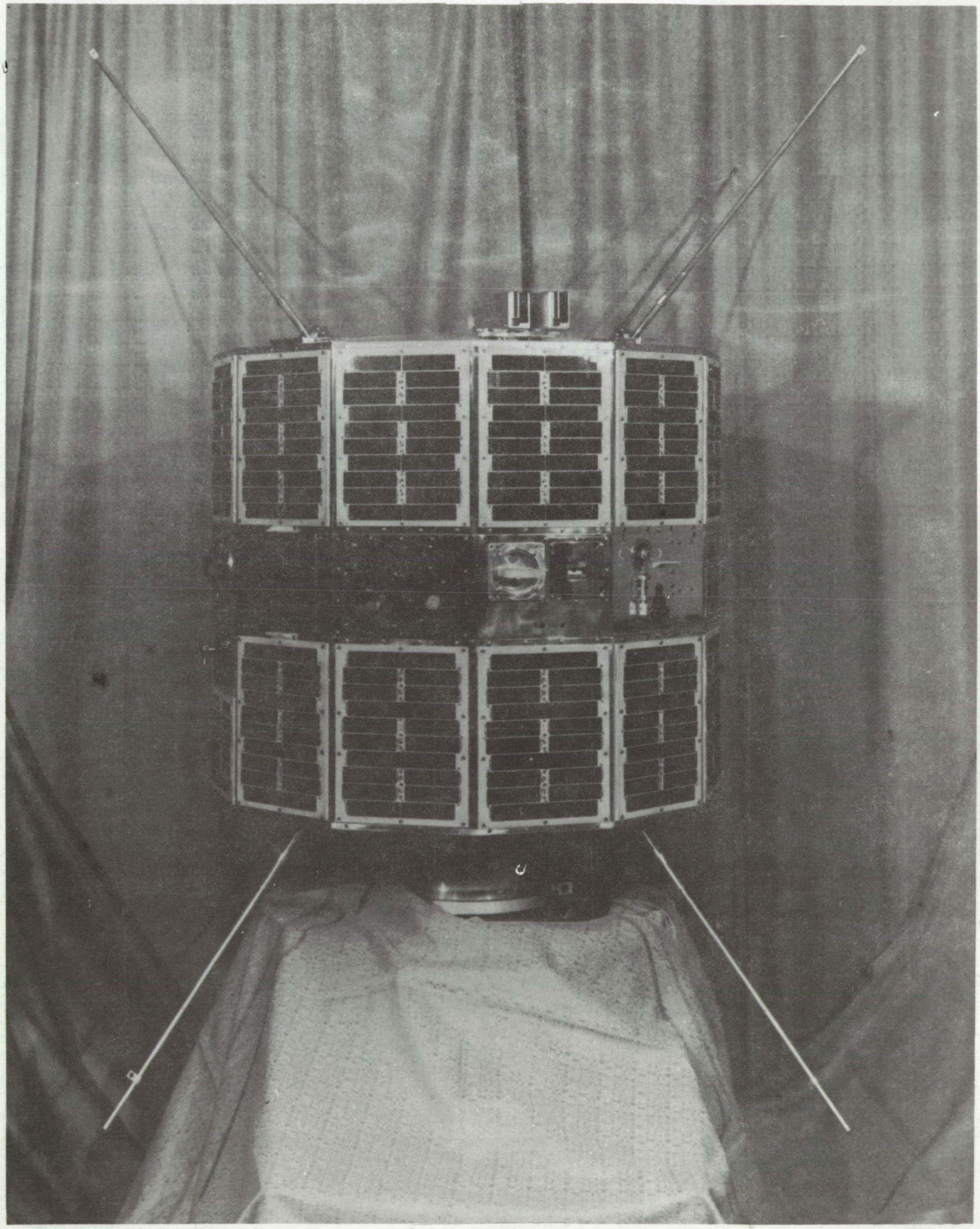
The spin-stabilized satellite will be placed in a 525-mile circular orbit inclined 60 degrees to the Equator.

Satellite commands and acquisition of both stored and real-time scientific data will be done at the NRL Tracking and Command Station, Blossom Point, Md.

NASA's Goddard Space Flight Center, Greenbelt, Md., will track the satellite and support NRL in acquisition of telemetered data.

The Scout launch vehicle is managed by NASA's Langley Research Center, Hampton, Va.

END OF GENERAL RELEASE; BACKGROUND INFORMATION FOLLOWS



BACKGROUND

The Earth is a body immersed in the atmosphere of a star, the Sun. Radiation from the Sun controls the environment of the Earth, of other solar system planets, and of interplanetary space. Because most emissions of radiation from the Sun are variable, the environment of the Earth is variable.

There is a cyclic pattern of solar activity, with maximum and minimum occurring about every 11 years, and a similar cyclic variation is evident in the properties of the Earth's atmosphere.

The present period is one of ascending solar activity. The next period of maximum activity is expected to be in late 1968 or in 1969.

SOLAR FLARES IMPORTANT

The solar flare appears to be the most important part of variable solar activity insofar as variable solar effects upon the environment of the Earth are concerned. In visible light, a flare is a sudden brightening of a part of the solar surface occurring in a few minutes and then slowly decaying over a period of hours.

X-rays and intensified ultraviolet light emitted during the life of a flare increase the ionization in the Earth's lower ionosphere and thus disrupt short-wave radio communications.

The largest flares also emit great numbers of energetic protons which increase the radiation levels in interplanetary space and in the space over the Earth's poles. Greater knowledge of the radiations emitted by the Sun is required to understand these interactions between solar events and the Earth's upper atmosphere and ionosphere.

The Sun is an astrophysical object of prime interest to man. It is the only star whose surface characteristics we can resolve and study. Knowledge gained by studying the Sun will help us understand and interpret the data from other stars.

VALUE OF SPACE RESEARCH

The techniques of space research permit scientists to expand solar studies in two ways: They can increase the resolving power of their telescopes through the elimination of atmospheric distortion, and they can observe over a very much larger part of the electromagnetic spectrum.

The Sun emits electromagnetic radiation covering the spectrum from radio waves through the visible and ultraviolet to X-rays and gamma rays.

Only a fraction of the radiation is in the visible part of the spectrum that a human eye can see. Parts of the radio portion of the spectrum can be observed on the ground.

The rest of the solar radiation is absorbed in the Earth's atmosphere and can be observed only with instruments above the atmosphere.

Some of the absorbed portions of the spectrum are doubly important. They are the portions which vary with solar activity. To understand the mechanism of a solar flare, studies of the ultraviolet and X-rays emitted during a flare (both of which are absorbed in the atmosphere) must be made. Since the radiation is absorbed in the upper atmosphere, these portions of the solar radiation control the nature of the upper atmosphere.

HOW SATELLITES HELP RESEARCH

Satellites contribute to studies of solar phenomena in three major ways. They make possible the study of the ultraviolet, X-ray and gamma ray radiation which is absorbed in the atmosphere; they permit continuous monitoring of this radiation during solar cycles of activity; and they provide higher resolution than ground equipment through the elimination of atmospheric scattering.

The primary reason for the solar studies is to expand human knowledge of space phenomena. While this is an exciting and important reason for the work, there are also practical benefits to be gained.

Knowledge of solar radiation and its effects on the terrestrial environment, together with continuous monitoring of the entire spectrum of solar radiation, should result in significant advances in the understanding of, and ultimate control over weather.

If significant advance signs of solar activity can be found and used to predict solar flares, this discovery will be a major contribution to communications, meteorology and manned space flights.

SEVERAL TECHNIQUES TRIED

In recent years, portions of the solar spectrum of radiations have been observed by ground-based monitors, balloon-borne instruments, high-flying aircraft, sounding rocket flights, deep space probes, and satellites. Scientists from industry, universities and several Government agencies have engaged in these efforts to unlock the Sun's secrets.

In 1949 the Naval Research Laboratory began a program of observation of solar ultraviolet and X-ray emissions in which the V-2 and, later, Aerobee and other sounding rockets were used to lift sensitive instruments (spectrographs and photometers) above the absorbing layers of the atmosphere.

In 1956, NRL began trying balloon-launched rockets, ROCKOONS, in an attempt to test, by direct measurement, the theory that solar X-rays were responsible for sudden ionospheric disturbances (SIDs) during solar flares.

A rocket fired during a solar flare July 20, 1956 indicated a surprisingly high intensity of X-rays between altitudes of 75 and 100 kilometers (47 to 62 statute miles). This X-ray flux was the first ever measured at such short wavelengths and at such a low altitude in the ionosphere.

SOUNDING ROCKETS USEFUL

Subsequent ground-launched sounding rockets gathered considerable new data on X-ray emissions during 1957 through 1959. Rocket measurements were made during three solar flares each of which was accompanied by a large sudden ionosphere disturbance.

Sounding rocket experience by NRL, NASA and others provided the brief glimpses of the Sun's spectrum necessary to guide development of satellite instrumentation.

In the study of such spasmodic events as solar flares, however, the sounding rockets have three handicaps: They cannot be launched quickly enough to see the early phases of flare; they cannot stay above the Earth's atmosphere long enough to measure time variations of solar X-ray and ultraviolet emissions; and it is difficult to keep instruments pointed at the Sun due to roll and yaw of the rockets.

Therefore, scientists turned to satellites capable of providing a stable platform for continuous solar monitoring.

In June 1960, the SR-1, designed and built by NRL, became the first successful solar X-ray monitoring satellite. Because X-ray monitoring could be conducted only when SR-1 passed over a telemetry station, the experiment depended on NASA for tracking and data acquisition.

SR-I RESULTS SIGNIFICANT

Despite its modest capabilities, 577 telemetry records were obtained from SR-I between June 22 and Nov. 1, 1960. One hundred of these showed measurable X-ray fluxes.

The results were significant. SR-I confirmed the hypothesis that solar X-rays cause sudden disturbances in the ionosphere during flares and determined the intensity necessary to trigger the changes.

It also established that active prominence regions, bright surges on the edge of the Sun, and certain solar-edge (limb) flares have the same characteristics as major disk flares. The disk is the central portion of the Sun as viewed from Earth.

Data from SR-I showed that solar X-ray fluxes provide a very sensitive measure of solar activity and can change significantly within one minute. It was found that long-duration X-ray events of moderate intensity can accompany rising prominences on the solar limb. Prominences are streams of cool gas that surge into the hot corona.

The second satellite in the SR series failed to achieve orbit and the third, SR-III, launched in June 1961, went into a tumbling mode that made data reduction difficult. Nevertheless, some of the data from SR-III have been reduced and found useful.

VARIATIONS DISCLOSED

The experiments of SR-I and SR-III made it evident that X-ray emission spectra vary greatly from one flare to another, and vary with time during a single flare event.

A highly successful satellite of the SR series was launched in January 1964 and was designated 1964-01D. During periods of good alignment relative to the Sun, the satellite provided 200 minutes-per-day of direct solar observations with measurements of solar X-ray emissions in the spectral bands of 1-8, 8-12 and 44-60 angstroms. The angstrom (A) is a measure of wavelength: 1 A equals 10^{-10} meter, or about four one-billionths of an inch.

The 44-60 A wavelength band proved especially sensitive to even the smallest solar event and its observed flux has been correlated with plage phenomena. Plages are bright, hot areas that appear on the Sun's photosphere. The photosphere is the visible disk of the Sun.

Another highly successful satellite of the SR series was launched in November 1965 and was designated Explorer XXX. It marked the first time that an attempt was made to use a data storage system in the series. Although the system malfunctioned after one month, the satellite continued to provide useful information in real time until November 1967.

Explorer XXX provided evidence that an increase in background solar X-ray emission can be interpreted as a precursor of flare activity and the subsequent disruption of radio communications. It also gave the best definition of the sizes of X-ray active regions thus far obtained. They were derived from observations as the satellite passed through the May 1966 eclipse shadow over Italy.

Since NASA was established in October 1958, there has been a close working relationship between NRL and NASA personnel in numerous scientific projects of mutual interest. Vanguard II, the first satellite launched by NASA (February 1959), was developed by an NRL team that was transferred to NASA.

Much of the NASA-NRL cooperation and interagency support has been in work related to solar physics. In the area of scientific exploration, an understanding of the universe, with particular emphasis on the solar system, remains the all-encompassing NASA objective.

SPACECRAFT DESCRIPTION

The spacecraft is a 12 sided cylinder, 30" in diameter across the corners and approximately 27" high. A central band contains X-ray photometers, Geiger tubes, photomultipliers, solar aspect system, and attitude control and spin nozzles.

Twenty-four solar cell panels cover the vertical surfaces. Electric power converted from solar energy by the cells is available to charge the nickel-cadmium batteries and to operate all spacecraft electrical systems. The symmetrical arrangement of the 7 X 10-inch panels assures adequate power.

The silicon solar cells will supply 27 watts of power. The portion of the shell not covered with solar cells is highly polished and has a thermal control coating applied. This will keep the internal temperature between 10 and 40 degrees Centigrade.

Low-thrust vapor jets are located adjacent to the center band to maintain spin rate and control of the spin axis. The spacecraft is planned to be spin stabilized at about one revolution per second. Two Sun sensors located 180 degrees apart generate properly timed jet pulses to precess the spin axis as necessary.

Output of five photometers can be switched to the low-power Digital Data Storage System (DDSS). The digitized data can be read out over a special transmitter by command when the satellite passes near the NRL ground facility.

Radio equipment on the satellite includes two analog transmitters for continuous operation, a digital transmitter to operate on command only, two four-element antenna systems, and two command receivers connected to a decoder system for placing the spacecraft and its experiments in desired operating modes.

One telemetry system consists of six subcarrier oscillators. The second system has four. Their mixed output modulates a transmitter which will send both housekeeping and X-ray data.

A magnetic core memory system will collect data from three X-ray band detectors over a 14-hour period and then, on command, transmit the digitized data to the NRL ground station. After that the system is reset to collect data for another 14-hour period.

SOLAR RADIATION MEASUREMENTS

All radiant energy, including that from the Sun, is emitted in many diverse forms and over a tremendous range of frequencies, or wavelengths. All these forms of radiant energy are electromagnetic in nature, obey the same basic laws and travel through space at the speed of light (about 186,300 miles-per-second). They differ in wavelength, origin and the ways in which they manifest themselves.

The entire array of electromagnetic radiations is called the electromagnetic spectrum.

Wavelengths corresponding to radio frequencies are usually expressed in meters; infrared in centimeters or microns; visible light, ultraviolet X-rays and gamma rays in angstroms. X-ray and gamma photons are often described by specifying their energy in electron-volts.

Instrumentation on the NRL/NASA Solar Explorer B will make measurements in the X-ray and ultraviolet regions of the electromagnetic spectrum.

Radiation measurements will be obtained by photometers, photomultipliers and Geiger tubes. Ultraviolet photometers will measure the region from 1080 to 1350 A.

The satellite measurements will be as follows:

WAVELENGTH (in angstroms)	TYPE OF EMISSION	DETECTOR TYPE
0.1 - 0.5	X-ray	Scintillation counter
0.5 - 3	X-ray	X-ray photometer & X-ray Geiger-Mueller tube
1 - 8	X-ray	X-ray GM tube and X-ray photometer
1 - 20	X-ray	X-ray photometer
8 - 16	X-ray	X-ray photometer
44 - 60	X-ray	X-ray photometer
1080 - 1350	Ultra violet	Ultra violet photometer
1225 - 1350	Ultra violet	Ultra violet photometer

-more-

The measurements are made in different but overlapping X-ray bands so that comparison of the different photometer outputs can be employed to construct a model of the solar X-ray spectrum and to provide an instantaneous indication of spectral changes with solar activity.

Satellite-obtained data on the daily average X-ray flux will be provided to the Institute for Telecommunications Sciences and Aeronomy, Boulder, Colo., for rapid publication.

SCOUT LAUNCH VEHICLE

Scout is a four-stage solid propellant rocket capable of carrying payloads of varying sizes on orbital, space probe or reentry missions. It is 72 feet long and weighs about 20 tons at lift-off.

Scout was developed and is managed by NASA's Langley Research Center, Hampton, Va. Prime contractor is Ling-Temco-Vought, Inc., Dallas, Texas.

Its four motors are interlocked with transition sections which contain guidance, control, ignition, instrumentation systems, separation mechanisms, and the spin motors required to stabilize the fourth stage. Guidance is provided by a strapped-down gyro system and control is achieved by a combination of aerodynamic surfaces, jet vanes and hydrogen peroxide jets.

Scout is capable of placing a 310-pound payload into a 300 nautical mile orbit or of carrying a 100-pound scientific package 18,000 miles from Earth.

Scout stages include the following motors:

First stage: Algol 11B
- 100,944 pounds thrust, burning 80 seconds.

Second stage: Castor 1
- 60,764 pounds thrust, burning 39.3 seconds.

Third stage: Antares (X-259)
- 20,942 pounds thrust, burning 34.9 seconds.

Fourth stage: FW4-S
- 5,746 pounds thrust, burning 31.5 seconds.

NRL/NASA SOLAR EXPLORER B PROJECT TEAM

For the National Aeronautics and Space Administration:

J. Holtz (Headquarters)	Program Manager
R. Miller (Headquarters)	Program Engineer
H. Glaser (Headquarters)	Program Scientist
J. Duke (Wallops)	Project Coordinator
P. Goozh (Headquarters)	Scout Program Manager
R. Schmitz (Langley)	Scout Project Office
R. Mitchell (Goddard)	Tracking and Data Acquisition

For the Naval Research Laboratory:

R. W. Kreplin, Project Scientist
P. G. Wilhelm, Project Manager
H. Friedman, Scientific Investigator
T. A. Chubb, Scientific Investigator

-end-